DYNAMIC AIR COOLING
The only coolant is air!

Frequently asked questions

Technical Information – Brief description of technology

We have developed a fundamentally new cooling technology. The essence of dynamic air cooling technology is the direct transformation of warm air into cold air through the use of gas-dynamic effects. The technology is based on a mixed universal cycle developed by the authors. The cycle combines two gas-dynamic and two thermodynamic processes:

- adiabatic and isentropic air compression in the compressor;
- adiabatic and isentropic expansion, cooling and acceleration of air in the working element;
- isothermal selection of the kinetic energy of the air flow in the air turbine;
- isobaric heating of air when removing heat from the cooled volume of the refrigerating chamber.

Compared with the traditional vapour compression technology:

- DAC uses air instead of hydrofluorocarbons to transfer energy, eliminating this source of pollution.
- It generates no thermal emissions - in all cooling applications, energy is removed from an air that is being cooled. In traditional cooling units, this energy is then wasted the heat is disseminated into atmosphere further boosting the global warming. In DAC, the energy extracted from the cooled air is not emitted as a heat into the atmosphere – instead it is turned into electricity.
- This electricity is used to contribute towards powering up our units, hence it is 30% more energy efficient compared with traditional compression AC/refrigeration system. This means that DAC is much cheaper to run.
- Due to much simpler designed and smaller size, manufacturing costs of our devices is 30% lower.

What stage is your technology at?

MVP

What problem have you identified that your technology addresses?

Problem 1: Air-conditioning and refrigeration
World needs much more air-conditioning and refrigeration then before:

- Worldwide power consumption for air conditioning alone is forecast to surge 33-fold by 2100 as developing world incomes rise and urbanization advances.
- Already, the US uses as much electricity to keep buildings cool as the whole of Africa uses on everything.

- By mid-century people worldwide will use more energy for cooling than heating.

However, the old technology cannot provide answer for this demand:
- cold is still overwhelmingly produced by burning fossil fuels
- emission targets agreed at international climate summits are very tight and limiting
- almost all cold is still produced by vapour-compression refrigeration, 100-year-old technology that uses refrigerants - hydrofluorocarbons (HFCs). However, HFCs produce greenhouse gases that can be up to 4,000 times more potent than carbon dioxide.

Problem 2: Food security
The world needs an awful lot more refrigeration - cold's role in food security is the key - as much as a third of all food is lost or wasted between harvest and home, mostly in the developing world. Losses amount to about 1.3 billion tons per year. Food is lost or wasted throughout the supply chain, from initial agricultural production down to final household consumption. Halving food waste would feed 800 million of the 1 billion chronically undernourished people in the world (research by the International Institute of Refrigeration).

Food losses represent a waste of resources used in production such as land, water, energy and inputs, increasing the green gas emissions in vain.

What is the potential impact of your technology? If applicable, please quantify the potential energy created and/or the energy and carbon emissions saved.

Replacing refrigerants that damage the atmosphere would reduce total greenhouse gases by the equivalent of 90bn tonnes of CO2 by 2050. Making more energy-efficient could double that. By comparison, if 1/2 world's population were to give up meat, it would save only 66bn tonnes of CO2. Replanting 2/3 of degraded tropical forests would save 61bn tonnes. A 1/3 increase in global bicycle journeys would save just 2.3bn tonnes).
Let´s take into consideration just to two smallest refrigeration segments (shipping containers and refrigerated trucks). We will be able to achieve the following benefits:
- There are 1,5M reefers (shipping containers) in the world = 7,5M t CO2 emissions
- There are 4M refrigerated trucks in the world = 20M t CO2

These segments alone equal to 50% of total yearly CO2 emissions of such country as Poland.

According to European Trading System: cost of cutting down one ton of CO2 = €7. This provides us with the total economic benefit of €192 500 000 just from these two market segments.

Worldwide, replacing refrigerants that damage the atmosphere would reduce total greenhouse gases by the equivalent of 90bn tonnes of CO2 by 2050. Hydrofluorocarbons (used in AC/refrigeration units) are the fastest-growing type of greenhouse gases. Their use around the world is increasing by 10-15% a year as the global need for cooling grows.

Though hydrofluorocarbons do not deplete Earth's ozone layer in the way the chlorofluorocarbons did, they contribute disproportionately to global warming – HFCs they are far more potent at trapping heat than carbon dioxide is. One of the most widely used hydrofluorocarbons R-134a (a refrigerant used in the AC equipment of cars) has a global warming potential (GWP) of 1,430. Weight for weight, it is 1,430 worse than carbon dioxide. Today R-134a is the most abundant hydrofluorocarbon in the atmosphere, accounting for ¼ of the total global annual output.

Result:
Replacing the hydrofluorocarbons that are used today in AC/refrigeration systems with less harmful chemicals could reduce the forecast global temperature increase by as much as 0.5°C.

What is the approximate size of the market that can be addressed with your technology?

If we address just two market segments (HVAC and shipping containers) the situation will be as following:

According to Statista report, the global heating, ventilation, and air conditioning (HVAC) market is projected to reach about €338.7bn by 2030, based on a compound annual growth rate (CAGR) of 3.9 percent between 2020 and 2030 . According to The Economist report, globally, by 2030, 460m new units of cooling equipment will be sold every year, compared with just 260m unit sales in 2010 and 336m in 2018. China, the US and India are by far the three largest markets – accounting for 49% of total sales in 2030. In 2024, India will overtake the US as a source of cooling demand, with 38.8m unit sales. Across the six markets, India and Indonesia are growing the fastest, albeit from lower bases than the US and China. Domestic refrigeration, residential AC and mobile AC will make up over 90% of unit sales in India and Indonesia in 2030. However, the fastest growth sector for both countries will be transport refrigeration which will grow at around 14% per year from 2018 to 2030 .
This means that businesses will play an increasing role in driving demand for cooling sales out to 2030, in addition to the important role they already play in the residential and mobile AC sectors (as real estate developers and automobile manufacturers). This highlights the imperative of business shifting to more efficient, climate-friendly cooling models.

Our addressable market is:
Total addressable market (TAM): Our target market is air conditioner market and refrigerated containers. According to Valuates report, global air conditioner market size is €72bn. Global refrigerated containers is estimated as 1.2m in units with average price €6,000, total market size is €7.2bn.
Serviceable available market (SAM): Our target market is Europe and America, so our serviceable available market is estimated at €15.84 bn (approximately 20% of TAM).
Serviceable obtainable market (SOM): This gives us a sizeable market entry for which we have a very good product fit. Our forecast is that in 5-year time, DAC will achieve €21m of revenue. This is just 0.2% of our SAM.

What benefits does your technology impact or support?

DAC is able to provide significant benefits:

Social:

- affordable cold and AC for people in regions with hot climates
- better preservation of food products, medical supplies
- increase in food production
- reduction of energy costs

Environmental:

- reduction of greenhouse gas emissions
- reduction of thermal pollution of the atmosphere
- ability to organize production with no CO2 emission limitations

How are others, or how might others attempt to solve the same customer or industry problem? If applicable, please include specific details including company and/or researchers names and relevant patents.

Cooling market globally is dominated by 12 large established players and a long tail of mid-sized companies. HVAC is an area that attracts many start-ups globally. Many of them focus on tracking & optimization of energy use. Yet a very small number is working on alternatives to traditional AC/refrigeration technologies. None of the current technology providers (in both HVAC and refrigerated container segments have a technology with a potential like DAC's. Most of them require either a chemical coolant (HFC or alternatives) or water (for evaporation) to be used. Our technology is environmentally friendly, much more energy efficient and requires much less complicated installation and service procedures. DAC offers significantly lower total cost of ownership for our customers—our biggest competitive advantage.

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Why is your solution the right one?

DAC USPs include:

- Immediate (seconds from the start of operation) cooling of air by -60°C. DAC technology can potentially provide cooling by -92°C.
- Cooling process occurs under very low pressure (up to 3 bars).
- DAC uses no chemical refrigerants.
- DAC system is smaller & more efficient (uses up to 30% less electricity) than a conventional vapor compression AC/refrigeration system.
- DAC is more affordable and easier to install.
- DAC does not qualify as hazardous for environment equipment (less bureaucracy= more attractive for customers)

Has your technology been vetted by any external sources (customers, investors, industry participants, tech transfer offices, etc). What have they told you?

So far the company achieved the following:

- First patents received in 2017;
- DAC received initial financing from VCs and angel investors in 2018;
- Winner of KyivTechHub Startup Competition in 2018;
- TRL 4 achieved (validation in laboratory environment), expected to reach TRL5 (validation in relevant environment) in 2020;
- Winner of European Startup Festival – Pitching Match London in 2019;
- Selected for participation in Brightlands Innovation Factory Acceleration program, Netherlands;
- DAC won 3rd place in 2019 Poland Prize Acceleration Program, funded by a government of Poland;
- Winner of Seal of Excellence in H2020 program, 1st stage
- Winner of Seal of Excellence in H2020 program, 2nd stage
- Polish patent application approved in February 2020;
- BridgeAlfa investment agreement with ShapeVC in March 2020;
- Winner of Sustainable Fast Track UK Award by Department of International Trade of UK;
- Participation in BRINC ScaleUP program, Poland in April-September 2020;
- Winner of the Vestbee Award at PowerUP! by EIT InnoEnergy Grand Final in July 2020.
- Winner of the KSSE Special Award at Tech and Start-Up days at European Economic Congress in September 2020.
- Winner of NCBR Fast track -Seal of Excellence Grant competition, with total grant funding 4M PLN.

What intellectual property exists? What rights do you have to the technology? What rights do others have to the technology?

All DAC IP has been developed internally & is fully owned by the company. We have secured 4 national patents within and outside EU. Polish patent application was submitted in February 2020. PCT application was submitted in February 2021. In general, we are planning to pursue aggressive patent filing to protect our technology. We develop an in-depth IP protection strategy taking into account the specific of our European & Asian target markets.
We have also carried out a preliminary patent search to assess our freedom to operate & discovered no patents that we might infringe on. This has been separately validated through our interaction with our early stage customers.